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13. Abstract: Designed to inform those persons involved in the Superfund pre-remedial process of possible data collection changes brought about by the proposed revisions to the Hazard Ranking System(HRS). This document is designed to assist Regional pre-remedial staff, State offices functioning under cooperative agreements, other Federal agencies, and contractors in conducting data collection activities during the interim period between proposal and promulgation of the revised HRS.

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SI/HRS INFORMATION BULLETIN

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This is the second bulletin designed to inform those persons involved in the Superfund pre-remedial process of possible data collection changes brought about by proposed revisions to the Hazard Ranking System (HRS) as required by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The revisions to the HRS were proposed on December 23, 1988. Following the public comment period, the Agency expects the final rule to be published in January 1990. The purpose of this *Bulletin* is to discuss data collection elements and procedures that might be appropriate if the final rule were to be promulgated in substantially the same form that it has been proposed. It is important for the reader to understand that substantial changes are possible as a result of public comment, ongoing research, and other facets of the rule-making process. Changes to the rule will, of course, result in changes to the suggested data collection procedures. Final guidance on how to conduct Preliminary Assessments (PAs), Screening Site Inspections (SSIs), and Listing Site Inspections (LSIs) will be issued shortly after the revised HRS is published as a final rule. This document is designed to assist Regional pre-remedial staff, State offices functioning under cooperative agreements, other Federal agencies, and contractors in conducting data collection activities during the interim period between proposal and promulgation of the revised HRS.

SARA Directives

SARA requires that the HRS be revised to account for several factors not included in the original model. Specifically, Section 105 of SARA requires that the new HRS take into account, to the extent possible, the following:

- Damage to natural resources associated with releases or threatened releases that may affect the human food chain.
- Contamination or potential contamination of the ambient air that is associated with a release or threatened release.

Section 105 also requires that human health risks associated with contamination or potential contamination of surface waters be appropriately assessed where such surface water is, or can be, used for recreation or potable water consumption. Additionally, Section 118 of SARA states that high priority (for National Priorities List [NPL] listing) shall be given to facilities where the release of hazardous substances or pollutants has resulted in the contamination or closing of drinking water wells or a principal drinking water supply.

Section 125 of SARA requires that the HRS be revised with respect to facilities which contain substantial volumes of wastes from fossil-fuel combustion (e.g., fly ash, bottom ash, and slag waste) in a manner which assures appropriate consideration of each of the following site-specific characteristics:

- The quantity, toxicity, and concentrations of hazardous constituents.
- The extent of, and the potential for, the release of hazardous constituents into the environment.
- The degree of risk to human health and the environment.

Finally, SARA requires the Environmental Protection Agency (EPA) to modify the HRS so that, "to the maximum extent feasible, [it] accurately assesses the relative degree of risk to human health and the environment posed by sites and facilities subject to review." Therefore, a number of changes to the HRS have been proposed by the Agency. In the proposed rule for the revised HRS, *all* of the factors from the current HRS have been revised in some way, with some "new" factors added and some "old" factors deleted. (Please refer to the *Federal Register* [Vol. 53, No. 247, pp. 51962-52081, December 23, 1988], which presents the complete text

of the proposed revised HRS.) The proposed changes that could have a significant impact on pre-remedial data collection activities include the following:

- **Onsite Exposure Pathway**—This is a new pathway for the revised HRS; soil sampling of residential, school, or day-care center property may be important.
- **Site Definition**—With some exceptions, the site is defined as an aggregation of sources (i.e., where the wastes were deposited, placed, or stored) rather than by the extent of contamination, including migration; such definition may require source and onsite sampling, or aerial photography, to delineate the "site." Targets are distance weighted (or for the surface water pathway, dilution weighted), so target distance from the "site" is important.
- **Drinking Water Targets**—Quantitative evidence of actual (as opposed to potential) exposure to contaminated drinking water is stressed; target distances have been increased. Potential targets are distance- or dilution-weighted.
- **Environmental Effects**—Actual and potential environmental impacts will receive greater emphasis; target distances are increased, and the types of "sensitive" environments to be considered have been expanded.
- **Air Route**—An observed release will no longer be required to score the air route; a mechanism to evaluate the potential for an air release has been included in response to SARA Section 105. The method to assess potential air releases is based on the physical characteristics of the site, the physical and chemical characteristics of the hazardous substances associated with the site, and the ways in which the hazardous substances are contained.
- **Observed Release**—The boundaries of a site will generally not be "extended" because of an observed release; with some important exceptions, target distances will be measured from the sources of contamination at the site (or from the probable point where contaminants enter a surface water body), rather than measuring the extent of contamination. The meaning of "significantly above background" has been quantified.
- **Hazardous Waste Quantity**—The proposed tiered approach would allow for the use of the actual amount of hazardous constituents if adequate sampling and analytical methods have been utilized, or if comprehensive process data or waste disposal records are available; if these concentration data are not available, waste quantity-as-deposited could be used. If waste quantity-as-deposited data are not available, then source volume or area could be used.

Pre-Remedial Process Changes

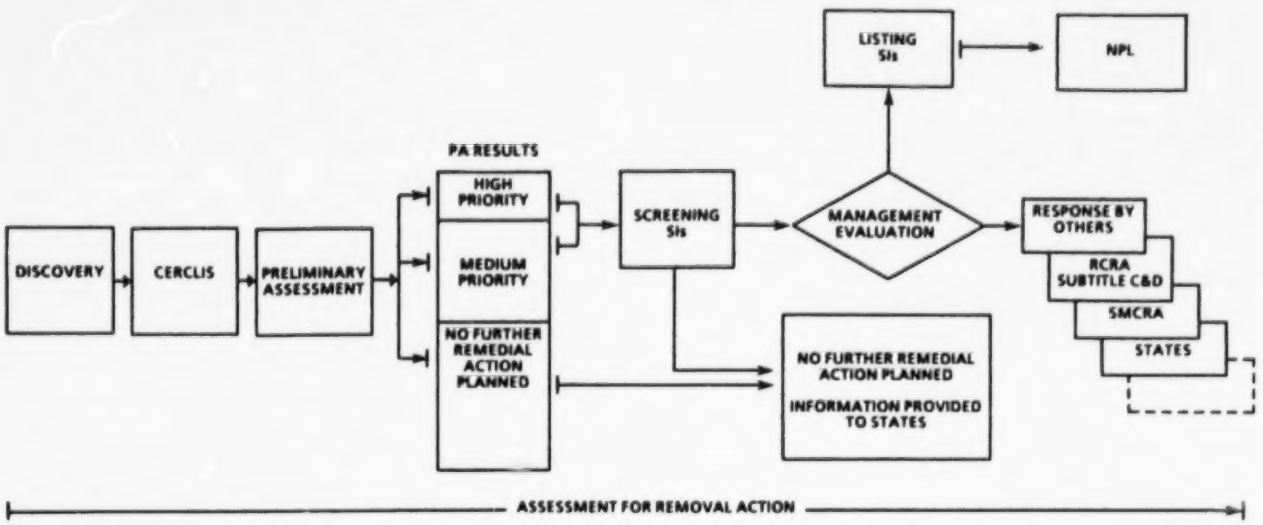
Procedural changes in pre-remedial activities, such as the expanded preliminary assessment (PA) and the division of the Site Inspection (SI) stage into two sequential components, the screening site inspection (SSI) and the listing site inspection (LSI), are already in place (see Figure 1).

The PA stage of the pre-remedial process primarily focuses on obtaining "desktop" data for those important HRS factors which enable the investigator to derive a projected HRS score that is representative of the site. At the present time, approximately 50% of the sites receiving PAs are recommended for SSIs. The SSI builds upon data collected during the PA by verifying and augmenting the data, as well as by collecting additional data, including environmental samples (usually 10-20 samples per site), to further characterize the site. The purpose of sampling during the SSI is to identify the types of contaminants present, to assess whether a release of hazardous substances has occurred, to look for evidence of actual human and environmental exposure to contaminants, and to determine the likelihood of the site scoring high enough on the HRS to be recommended for an LSI. The LSI is conducted only on sites that have a high probability of being listed on the NPL as one of the nation's worst hazardous waste sites. The LSI evaluates all *appropriate* pathways through expanded sampling and results in an HRS scoring package.

This issue of the *Bulletin* will not focus on specific elements of the PA, SSI, or LSI; rather, it will discuss the cumulative body of data needed to complete the pre-remedial process for sites that have a high probability of being placed on the NPL. At the present time, it is estimated that between 5 and 10% of the sites on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) will result in an NPL listing. Most sites will then only receive a subset of the evaluation activities described in this document, depending on the point in the process when it is decided that they do not warrant further Superfund pre-remedial action. Regardless of where the specific data collection activities occur in the pre-remedial process, the major objective of the PA, SSI, and LSI process is to determine the proper disposition of a site (i.e., NPL or non-NPL), based on the factors found in the HRS. The HRS remains the primary mechanism by which a site is evaluated for placement on the NPL.

Figure 1

PRE-REMEDIAL STAGE OF SUPERFUND PROCESS



The present issue of the *Bulletin* is based on information that is provided in greater detail in the *Federal Register*. It will briefly describe the proposed HRS revisions that affect multiple pathways and individual pathways and then discuss how the changes might affect data collection procedures. The suggested approach involves separating data collection into the following elements: background data collection, site/environs reconnaissance, and sampling. It is important to keep in mind that some of the information listed under background data collection and site/environs reconnaissance will be gathered during a PA; however, these data will then be refined and augmented during the SSI, with limited environmental samples collected as well. During the LSI, all *appropriate* pathways will be evaluated, and the suggested approach will provide the data needed for a complete HRS package.

Each of the three data collection elements is discussed below.

- **Background Data Collection Activities**—This will encompass obtaining and reviewing available reports, maps, and photographs for "desktop" information that is needed for the HRS. Examples include U.S. Geological Survey (USGS) maps and reports to obtain hydrogeologic and stream flow data, Soil Conservation Service (SCS) soil-type maps, information from file searches, data on fishery resources, data on nearby drinking water sources and usage, aerial photography to assist in "site" definition as well as determining land uses and recreation areas surrounding the site, and census reports to obtain population figures.
- **Site/Environs Reconnaissance**—The data collection activities for site/environs reconnaissance will include determining source dimensions, source containment, site accessibility, and the locations of nearby receptors or targets; confirming nearby land uses and recreational water use; and characterizing drainage areas and surface water bodies (flow type, stream bed morphology, etc.) if gauging station information is not available.
- **Sampling Strategy**—The SSI sampling strategy should be appropriate to support the recommendation that a site move forward to an LSI or be designated as "no further remedial action planned." As stated previously, the purpose of sampling during the SSI is to identify the types of contaminants present, to assess whether a release of hazardous substances has occurred, and to look for evidence of actual human and environmental exposure to contaminants. The LSI sampling strategy should be sufficient to

document an observed release, when appropriate; characterize sources and waste types; determine the areal extent of "onsite" contamination; and, if warranted, determine the actual contamination to drinking water, recreational, and environmental resources.

Although specific guidance as to the full extent and character of each phase of the pre-remedial process is not yet available, it is fair to say that PA, SSI, and LSI activities will each comprise a subset of the data collection activities described in the following sections. A discussion on integrating all aspects of the pre-remedial process is given at the end of the *Bulletin*. The reader should be aware that the items discussed in this *Bulletin* are *proposed* changes. Several of the proposed factors could be deleted or modified, based on comments on the proposed HRS and subsequent revisions for the final HRS.

HRS Revisions Affecting Multiple Pathways

The following is a summary discussion of the HRS revisions to factor categories that affect multiple migration pathways. These categories include hazardous waste quantity, toxicity, observed release, distance/dilution weighting, risk to the maximally exposed individual, the use of health-based benchmarks in evaluating target populations, and sensitive environments.

Hazardous Waste Quantity: In the current HRS, hazardous waste quantity is calculated as the amount of waste deposited containing hazardous substances. For the revised HRS, the Agency is proposing a tiered approach that will allow the use of the best available data. The Agency will consider three levels of information, in order of preference:

1. Amount of hazardous constituents (or the actual amount [mass] of hazardous substances deposited at the site).
2. Amount of waste quantity as deposited (total waste stream).
3. Disposal capacity of sources (volume or area).

The Agency believes that the tiered approach will encourage the use of concentration data, when it is available, and will also provide a site-specific measure when site waste-stream quantity is not known, rather than using a generic default value. This approach applies to the ground water, surface water, and air pathways. The hazardous waste quantity factor for these pathways reflects the magnitude and duration of potential releases. For the onsite exposure pathway, the question is not whether hazardous substances have been released and have migrated, but rather whether there is potential direct contact with the contaminated area. The waste quantity factor for this pathway would therefore be evaluated, based on the areal extent of surficial contamination. If information on the areal extent of contamination is not available, default measures applicable to each source type can be used to assign a value by using the following data (in order of preference): amount of hazardous substances deposited at the site, amount of waste as deposited, and source volumes.

Toxicity: This is one of the factors in the waste characteristics category that is evaluated for all pathways. Under the current HRS, toxicity is evaluated based primarily on acute toxicity of hazardous substances. To account for chronic exposure in addition to acute exposure, the Agency is proposing to evaluate hazardous substances for three kinds of toxicity: acute toxicity, carcinogenicity, and chronic noncarcinogenicity. In cases where a score can be derived for all three kinds of toxicity, the highest of the three scores will become the value assigned for the toxicity factor. The Agency is also proposing to include aquatic toxicity ratings to assess potential risks to ecosystems. Table values for toxicity and other waste characteristics will be developed so that the appropriate HRS score for the hazardous substance(s) present can be easily identified.

Observed Release: The scoring approach for this category will remain the same; however, the Agency is proposing criteria which more precisely define when an analytically measured release is to be considered significantly above background. The proposed criteria are as follows:

- If no background concentration is detected, a significant release is three or more times the detection limit.
- If the background concentration is greater than or equal to the detection limit but less than two times that limit, a significant release is greater than or equal to three times the applicable background concentration or greater than or equal to four times the detection limit, whichever is less.
- If the background concentration is greater than or equal to twice the detection limit, a significant release is greater than or equal to twice the applicable background concentration.

Distance/Dilution Weighting of Targets: The current HRS directly weights the population factor by distance/dilution only for the air pathway. The Agency is proposing that the revised HRS use distance- and dilution-weighting factors for all pathways to calculate the scores for population and sensitive environments that are potentially exposed to contamination. The weighting factors would reflect the expected decreased concentration (i.e., dose) from exposure as substances disperse or are diluted.

Risk to the Maximally Exposed Individual (MEI): To improve the overall assessment of potential risks to human health, EPA is proposing to consider the maximally exposed individual, or those individuals

who are potentially exposed to the highest concentrations (and thus receive the highest dose) of the hazardous substance in question. In most cases, the MEI risk for the ground water pathway will be assessed based on the distance from the site to the nearest drinking water well. (Exceptions are karst aquifers and wells showing attributable contamination above health-based benchmarks.) Within the surface water pathway, the MEI is represented by the dilution-weighting factor that is assigned to the nearest drinking water intake. (Exceptions are any intake showing attributable contamination above health-based benchmarks.) For the air pathway, the MEI would be based on the distance from the emission sources on the site to the nearest individual, which is represented by the distance to the closest residence or regularly occupied building or area.

Use of Health-Based Benchmarks: The current HRS does not consider whether the specific concentrations of hazardous constituents in affected media are above health-based benchmarks, but only whether these contaminants are significantly above background levels. In response to SARA directives, the Agency is proposing revisions to the ground water and surface water pathways that would take into account situations where contaminants detected are not only above background levels, but also above health-based standards. The target population factors in both of these pathways have been divided into four groups: (1) population exposed to contaminant concentrations above health-based benchmarks; (2) population exposed to concentrations that are above background levels, and are greater than 0.1% of the health-based benchmarks; (3) population exposed to concentrations that are above background levels, but do not exceed 0.1% of the health-based benchmarks; and (4) population with no documented exposure, referred to as the potentially exposed population. Those exposed individuals in the first and second groups are emphasized more than those in the third group. The individuals in the fourth group (individuals with potential exposure) will be distance/dilution weighted.

Sensitive Environments: In the current HRS, if more than one sensitive ecosystem exists within the target distance, only the one with the highest score is included. The proposed HRS will base the sensitive environment factor in the surface water and air pathways on the sum of the values for all appropriate sensitive environments within the target distance, with each ecosystem weighted for distance or dilution. For the onsite exposure pathway, only terrestrial sensitive environments with observed contamination will be considered. The types of sensitive environments considered for each pathway have been significantly expanded as well.

HRS Revisions Affecting Individual Pathways

GROUND WATER MIGRATION PATHWAY

The proposed revisions to the ground water migration pathway respond to SARA's stipulation to accurately assess the relative degree of risk to human health and the environment and to "give a high priority to facilities where the release of hazardous substances . . . has resulted in the closing of drinking water wells or has contaminated a principal drinking water supply." The revised ground water pathway would retain the same structure as in the current HRS. In both versions, the likelihood of release to ground water is multiplied by the score from the waste characteristics category and from the targets category to obtain an overall pathway score. However, the individual parameters specific to each category will change. The proposed changes include these general considerations:

- Evaluation of targets and scoring of aquifers—In the revised HRS, if more than one aquifer underlies a site, each of the aquifers is scored, and the aquifer with the highest score is used to evaluate the site. The targets to be evaluated are those that draw water from the aquifer being evaluated *and* from all overlying aquifers (except for injection wells and similar situations).
- Distance weighting of targets—Because, under most circumstances, the concentration of hazardous substances declines as the substances migrate from a site, the revised HRS would apply distance/dilution weighting to targets located at varying distances from a site to better reflect the differential exposures and risks. For the ground water pathway, distance/dilution weighting of targets would be used for the potentially exposed populations.
- Distances considered in evaluating aquifers and targets—EPA is proposing to extend the target distance limit within which population is evaluated from 3 to 4 miles *from the sources.* Target populations drawing water from wells beyond the 4-mile limit could be counted if they exhibit documented contamination attributable to the site. The Agency is proposing to evaluate aquifer interconnections within a 2-mile radius and aquifer discontinuities within a 4-mile radius.
- Aquifer interconnections and discontinuities—Interconnected aquifers can be combined for scoring purposes. Two or more aquifers are considered interconnected if they act as a single hydrologic unit. Evidence of hydrologic interconnection includes pump tests, contamination shown in a deeper layer, absent or discontinuous confining layers, or indications that an upper aquifer provides significant if not total recharge

to the lower aquifer. Aquifer discontinuities result when a geologic, topographic, or other structural feature completely transects an aquifer, and thus prevents water from flowing out of or into the aquifer. If a discontinuity exists within the target area, any part of the aquifer beyond the discontinuity is not counted unless the discontinuity does not entirely transect the target area.

- Consideration of karst aquifers—In the current HRS, sites with karst terrain are not given any special consideration. The proposed revisions would reflect the high potential for contaminants to migrate through karst aquifers with little reduction in concentration of hazardous substances.

Among the other proposed changes to the HRS for the ground water pathway are the following:

Potential to Release: This category contains one new factor: sorptive capacity. The physical state factor has been deleted for the revised HRS. Four other factors—depth to aquifer, hydraulic conductivity, net precipitation, and containment—have been revised.

- Sorptive Capacity—This is a new factor, which reflects the potential for geologic materials to chemically absorb substances and thereby retard hazardous substance migration. The sorptive capacity factor is based on the composition and thickness of geologic materials beneath the site.
- Depth to Aquifer/Hydraulic Conductivity—In the current HRS, the depth to aquifer factor assigns a value of zero to an aquifer deeper than 150 feet. In the revised HRS, aquifers with depths up to and exceeding 800 feet would be assigned values using a matrix that combines depth with hydraulic conductivity. The scoring for hydraulic conductivity is now based on the thickness and properties of all intervening strata, not just the one with the lowest permeability. In combination, these two factors give an indication of the relative travel time required for substances to reach an underlying aquifer.
- Net Precipitation—Under the revised HRS, net precipitation is determined by using a methodology based on the summation of 12 monthly net precipitation values (with negative values set to zero), rather than seasonal or annual net precipitation. As a result, the net precipitation value will better reflect the potential of hazardous substances to migrate to aquifers.
- Containment—The revised HRS expands the range of values that could be assigned for this factor and provides more detailed descriptions of each type of containment.

Waste Characteristics: Under the current HRS, a score was assigned for waste characteristics by evaluating the toxicity and persistence of hazardous substances. In the revised HRS, the Agency is proposing to combine toxicity with mobility rather than persistence for the air and ground water pathways. The toxicity/mobility of the substances identified does not have to be researched, but generally will be available in look-up tables. Waste quantity is also a factor under this category. Refer to the previous discussion on waste characteristics in the section *HRS Revisions Affecting Multiple Pathways*.

Ground Water Targets: Currently, the ground water targets category is evaluated by considering two factors: ground water use and a matrix factor that combines distance to the nearest well with the population served by ground water. Four factors are proposed to be evaluated under this category for the revised HRS: ground water use, Wellhead protection areas, the MEI, and population served segmented into four types of exposure (see *HRS Revisions Affecting Multiple Pathways*).

To support the proposed revisions to the ground water pathway, some more detailed, site-specific information may need to be collected. Recommendations for background data collection, site/environs reconnaissance, and sampling strategy with respect to the ground water pathway are discussed below.

Background data collection:

- Collect information on the type and quantity of waste disposed at the site and source containment.
- Seek archival aerial photography to assist in "site" definition.
- Collect USGS reports, well logs, and other available geologic data to delineate stratigraphy near the site.
- Collect data on the population drinking ground water drawn from within the target distance limit, allocated to seven distance rings. If more than one aquifer is used, determine the population drinking from each aquifer.
- Look for documented quantitative evidence of nearby drinking water wells contaminated with substances attributable to the site. Qualitative evidence can be used to establish sampling locations.

Site/environs reconnaissance:

- Consider using current aerial photography if defining the "site" is difficult to do during the site reconnaissance.
- Take photographs, detailed notes, and dimension measurements needed to determine "as deposited" waste locations, containment, and waste quantity.
- Confirm the MEI location/distance, as well as other major drinking water targets.

Sampling strategy:

- Sample waste areas to determine the types of hazardous substances present and to estimate source dimensions, if appropriate.

- Sample to establish an observed release if such is likely; the closest downgradient well is the best candidate; in general, "extending" the site is no longer a consideration.
- Consider the need to drill boreholes or perform geophysical studies to determine stratigraphy underlying the site if existing data are not adequate.
- Sample selected nearby drinking water wells, if they are likely to be contaminated with substances attributable to the site.

SURFACE WATER MIGRATION PATHWAY

Some of the major changes to the surface water pathway under consideration are in response to SARA's requirements regarding the need to take into account, to the extent possible, the damage to natural resources that may affect the human food chain. Another major requirement of SARA is that the revised HRS appropriately assess the risk from use of contaminated (or potentially contaminated) surface waters for recreation or potable drinking water. To meet the general and specific provisions of SARA, the surface water pathway will consider threats to human health through drinking water, the human food chain, and recreational water use, as well as threats to sensitive environments. The Agency is proposing to place more emphasis on environmental damage and to expand the types of environments considered. Each of these threats will be evaluated separately for waste characteristics (except hazardous waste quantity) and targets. The likelihood of release category evaluation will be common to all threats, as will the proposed target distance increase to 15 miles downstream for both flowing and static water. Populations and environments that are potentially exposed to contamination will be dilution weighted. The weighting factor is related to flow characteristics of the surface water body, and reflects the diminishing risks as substances are diluted.

As in the current HRS, the likelihood of release category is evaluated as an observed release or as a potential to release. The observed release category is discussed in the section *HRS Revisions Affecting Multiple Pathways*. The potential to release category assesses the likelihood for hazardous substances to migrate from a site to surface water. It is proposed that this category replace the route characteristics and containment factors from the current HRS with two new factors: potential to release by overland flow and potential to release by flooding. These two factors are discussed below:

Potential to Release by Overland Flow: A score for overland release potential can be derived by calculating the sum of two factors: runoff value and distance to surface water. The runoff value includes three parameters—runoff curve number, rainfall, and upgradient drainage area. The runoff curve number is based on land use and hydrologic soil type between the source and surface water. It is a measure of the ability of soils and the type of land surface to minimize runoff. The rainfall parameter has been proposed to change from a 1-year, 24-hour rainfall to a 2-year, 24-hour rainfall. The drainage area provides a measure of the amount of land surface area that can carry runoff across the site. The factor for distance to the nearest surface water body is a measure of the potential for hazardous substances transported via overland flow from the site to reach a surface water body. For the proposed HRS, only surface water bodies within 2 miles of the site are to be evaluated.

Potential to Release by Flooding: This proposed new category considers the potential for hazardous substances to be released to a surface water body when a site is flooded. The potential for release due to flooding is determined by multiplying a flood containment factor (i.e., methods that are being used, if any, to prevent the release of hazardous substances if a site is inundated by a flood) by a flood frequency factor. The value assigned will depend on the expected frequency of flooding, for which containment is judged to be inadequate.

The waste characteristics of hazardous substances are evaluated for each of the four threats by adding a value from a matrix of toxicity and persistence to a value based on hazardous waste quantity. Hazardous waste quantity and toxicity are discussed in the section *HRS Revisions Affecting Multiple Pathways*. Persistence of hazardous substances is evaluated based on the expected reduction of the hazardous substance concentration as a result of five decay processes over the target distance limit. A value for persistence will be assigned, based on the half-life of the hazardous substance in surface water and the type of surface water body (e.g., river, stream, or lake). The calculation of a value for waste characteristics differs slightly for each threat category or subpathway, as discussed below.

Waste Characteristics for Drinking Water Threat: For each substance actually or potentially released from the site, persistence will be combined with toxicity in a matrix. The substance with the highest toxicity/persistence value will be used in calculating the drinking water waste characteristics category value.

Waste Characteristics for Human Food Chain Threat: Toxicity and persistence will be evaluated for those substances with the highest bioaccumulation potential value. Otherwise, hazardous waste quantity and toxicity/persistence are calculated in the same way as the drinking water waste characteristics factor. However, the hydrologic category used to assign the persistence value will be based on the predominant type of water body between the probable point of entry and the nearest fishery.

Waste Characteristics for Human Recreation Threat: Toxicity and persistence will be evaluated for those substances with the highest dose adjusting factor value. The dose adjusting factor represents the ratio of the dose to an individual that would be obtained via recreation to the dose that would be obtained via consumption of the same water.

Waste Characteristics for Environmental Threat: Ecosystem toxicity will be combined in a matrix with persistence and will be evaluated for all hazardous substances at the site which are available to migrate to the surface water body. Because exposure of sensitive environments is more likely to be chronic than acute, ecosystem toxicity scores will be assigned by using the following hierarchy of data: EPA chronic water quality criteria for the substance; EPA acute water quality criteria for the substance; or the lowest LC_{50} value reported in peer-reviewed literature for the substance.

The targets category reflects the human population and sensitive environments possibly at risk from an actual or potential release of hazardous substances. As mentioned previously, each of the four threats is evaluated separately as a subpathway for waste characteristics and targets. Targets are discussed below.

Drinking Water Targets: A value for the drinking water targets score is assigned based on evaluating surface water use, population, and the MEI. The MEI is discussed in the section *HRS Revisions Affecting Multiple Pathways*. The surface water use factor is divided into two subfactors: drinking water use and other water uses. The drinking water use factor takes into account whether the drinking water is a public or private water supply and whether alternative drinking water supplies exist. Other surface water uses include commercial crop irrigation, livestock watering, and food preparation. The population factor is an indicator of the number of people actually or potentially at risk from exposure to hazardous substances in drinking water.

This factor will consider population groups segmented by actual or potential exposure, as previously discussed in the section on the *Use of Health-Based Benchmarks*.

Human Food Chain Targets: The human food chain target value is derived by summing two factors: population and fishery use. The population factor value is the sum of two subfactors: potential human food chain contamination and actual human food chain contamination. Actual human food chain contamination is demonstrated when there is attributable contamination above Food and Drug Administration (FDA) action level standards, or when a fishery has been closed and the hazardous substance that caused the closing has been documented in an observed release from the site. If the conditions for actual human food chain contamination are not met, scoring of the fishery is based on potential contamination. The fishery use factor reflects the nature and utility of fisheries located along the target distance limit. A value is assigned for commercial fishing, subsistence fishing, and recreational or sport fishing.

Human Recreational Targets: This category has been added to consider threats from dermal contact, inhalation, and ingestion during water recreation activities (i.e., swimming or fishing). The recreational use value is derived from an accessibility/attractiveness factor (e.g., designated swimming beaches, boat ramps, boat rental facilities, marinas, campgrounds, etc.) for the recreation area, and from the number of people residing within the specified target distance categories for the recreation area.

Environmental Targets: This category will be used to evaluate the threat associated with actual or potential release of hazardous substances to surface-water-related sensitive environments. The revised HRS places more emphasis on actual environmental exposure and expands the types of environments to be considered. Sensitive environments are divided into three exposure groups: those with contamination above ecological-based benchmarks; those with contamination not exceeding ecological-based benchmarks, but above background levels; and those that could potentially be contaminated.

Recommendations for the surface water data collection methodology are discussed below.

Background data collection:

- Collect USGS reports and other available data on hydrology near the site; also obtain topographic maps, floodplain maps, and SCS soil-type maps.
- Collect information on type and quantity of waste deposited and on source containment.
- Seek archival aerial photography to assist in "site" definition and determination of overland flow paths.
- Determine the size of the target population, based on the location of water supply intakes within the target distance limit.
- Collect data on fishery production, recreational water use, and sensitive environments within the target distance.
- Obtain the required average flow rates at target locations from USGS or other sources.
- Look for documented quantitative evidence of "attributable" contamination near drinking water intakes, sensitive environments, fisheries, and recreation areas. Qualitative evidence can be used to establish sampling locations.

Site/environs reconnaissance:

- Consider using current aerial photography to help define the "site" and overland flow paths.
- Take photographs, detailed notes, and dimension and distance measurements needed to determine

"as deposited" waste locations, containment, waste quantity, and characteristics of the overland flow path and drainage area for each source.

- Estimate stream width and depth, as well as the type of flow (quiet flowing or turbulent), or develop estimates of watershed area if data on flow rates are not available.
- Recommend visual reconnaissance to document the accessibility/attractiveness of recreation areas adjacent to surface water bodies and to characterize "quiet flowing" streams.

Sampling strategy:

- Sample waste areas to determine the types of hazardous substances present and to estimate source dimensions, if appropriate.
- Sample primarily to document an observed release near the probable point of entry into a surface water body.
- Recommend sampling at nearby drinking water intakes, fisheries, recreation areas, and sensitive environments which meet both of the following conditions: contamination is likely at the sampling location, and contamination is likely attributable to the site.
- Consider sampling sediments to "extend" the point from which to measure the 15-mile target distance limit if contamination attributable to the site is likely to be found and if there is a significant target which could be included.

AIR MIGRATION PATHWAY

The principal revision to the air pathway responds to Section 105(a) of SARA and concerns the addition of a mechanism to evaluate potential air contamination in the absence of data to document an observed release. Observed release has not changed substantially for the air pathway (but do refer to the section *HRS Revisions Affecting Multiple Pathways)*. The general changes to the hazardous waste quantity, toxicity, and target factors are also discussed in *HRS Revisions Affecting Multiple Pathways*.

Three factors are used to evaluate a site's potential to release hazardous substances: source type, source mobility, and source containment. Source type considers the size and type of waste disposal locations (e.g., drums, lagoon, landfill, etc.). Each emission source on the site that meets a minimum size requirement is assigned a source-type factor value. Source mobility reflects the propensity of a hazardous substance to migrate from a source as a gas or a particulate. For gaseous substances, the mobility factor will be based on three physical/chemical characteristics: vapor pressure, Henry's constant, and dry relative soil volatility. (Look-up tables will be provided to give these values for a number of substances.) For particulates, the mobility factor will be evaluated, based on the Thornthwaite Precipitation-Effectiveness (PE) index, a surrogate measure of the relative moisture content of the soil. The third factor, containment, evaluates the ability of natural or man-made barriers to inhibit the release of hazardous substances.

Recommendations for the data collection methodology to evaluate the air pathway are discussed below.

Background data collection:

- Collect information on the type, quantity, and disposal mode of waste deposited, as well as any historical information on air releases from the site.
- Seek archival aerial photography to assist in "site" definition.
- Collect data on population distribution and location of sensitive environments within the target distance, allocated to eight distance categories; the target distance will remain 4 miles.
- Collect information to identify the closest of each of the six types of land uses within 4 miles (commercial/industrial/institutional, single-family residential, multi-family residential, parks, prime agricultural, and non-prime agricultural).

Site/environs reconnaissance:

- Take photographs, detailed notes, and dimension measurements needed to determine emission sources, containment, "as deposited" waste locations, and waste quantity.
- Consider using current aerial photography if defining the "site" during the site reconnaissance is difficult.
- Recommend visual reconnaissance to determine/confirm the distance to the MEI and the closest of each of the six types of land uses and their distance from the site.

Sampling strategy:

- Suggest discretion/prioritization in obtaining samples intended for Contract Laboratory Program (CLP) analysis; based on site conditions, climatology, and equipment requirements, sampling to prove an observed release may *not* be appropriate at all sites.
- As a general rule, formal sampling for air release data may not be necessary; consider collecting data for the potential to release category; also field screening data may be used to determine whether a return air-sampling site visit is warranted.

ONSITE EXPOSURE PATHWAY

One of the most significant changes to the HRS under evaluation is the addition of a fourth pathway, the onsite exposure pathway. Although the current

HRS includes a direct contact pathway that evaluated the potential for direct exposure to hazardous substances at a site, the score for this pathway was not included in the total HRS migration score. However, to respond to SARA's directives and based on an assessment of approximately 100 Records of Decision, a new exposure pathway was developed, and it is proposed that its score be included in a site's overall HRS score. To score any of the factors under this pathway, there *must* be documented, analytical evidence of contamination above background levels in soils, seeps, surficial or shallow buried wastes, or in surface impoundments. If there is no such evidence, this pathway will receive a score of zero. Specific factors of the onsite exposure pathway are described below.

Likelihood of Exposure (Resident or Onsite Population): The resident population likelihood of exposure would be evaluated based on the presence of contamination and not on release potential. If there is no analytical evidence of soil contamination or of hazardous substances present in sources containing shallow wastes (e.g., lagoons), then this factor and the onsite exposure pathway will receive a value of zero.

Targets (Resident or Onsite Population): The resident-population targets category is based on three factors: high-risk population, total resident population, and terrestrial sensitive environments. For any of these three population groups to be considered, there must be observed contamination attributable to the site within the property boundary of a residence, school, or day-care center, or within the boundaries of a terrestrial sensitive environment. The three resident-population target factors are discussed below.

- High-risk population—This population group includes children under 7 years of age and is evaluated because research has shown that children have a higher soil ingestion rate than adults. The children counted should include those who live on or attend school or day care on the contaminated property.
- Total resident population—The total resident population includes everyone who lives on or goes to school or day care on the contaminated property.
- Sensitive environments—For this pathway, only terrestrial sensitive environments are considered. Aquatic ecosystems are addressed in the surface water pathway.

Likelihood of Exposure (Nearby Population): This category will be scored by considering the quantity of waste on the site and the accessibility and frequency of use of the site. The waste quantity will be evaluated primarily based on the area of contamination. For those sources where the areal extent of contamination is not readily determined, default mechanisms applicable to each source type can be used to assign a value. Accessibility reflects the measures taken to limit access (natural or man-made barriers). As with *Likelihood of Exposure (Resident Population)*, if there is no evidence of soil contamination, or of hazardous substances present in sources containing shallow wastes, then this factor and the pathway will receive a value of zero.

Targets (Nearby Population): Individuals will be counted in the nearby population if they live or attend school or day care within 1-mile travel distance of the contaminated site.

Recommendations for background data collection, site/environs reconnaissance, and sampling strategy for the onsite exposure pathway are discussed below.

Background data collection:

- Look for existing file information, analytical data, and aerial photography to examine the types of waste disposed and the patterns of disposal.
- Obtain population data within 1-mile travel distance of the "site" (possibly subset of air data). The 1-mile travel distance is the overland distance an individual would have to travel to reach the site.
- Refine population data, if necessary, to identify "high risk" populations for the resident population.
- Determine whether the site is near any terrestrial sensitive environments (subset of air data).

Site/environs reconnaissance:

- Measure areas of apparent contamination (e.g., stained soils) or of shallow waste disposal areas (e.g., lagoons).
- Take photographs and field notes to document the accessibility factor.
- Conduct a visual reconnaissance to determine/confirm the location of residences, day-care centers, schools, and terrestrial sensitive environments, and to determine the 1-mile travel distance.

Sampling strategy:

- The onsite pathway *requires* analytical demonstration of onsite surficial contamination; otherwise, the pathway receives a score of zero.
- For the onsite pathway, the "site" is defined by the extent of attributable surficial contamination. It is not necessary to define the full extent of onsite contamination or all locations of surficial contamination. Carefully evaluate "prime" locations to find contamination and try to define areas with as few samples as possible. Make maximum use of screening techniques using portable instruments to narrow down/focus on areas to sample for complete laboratory analysis.

- Sample primarily to document surficial contamination at residential terrestrial properties, schools, day-care centers, and terrestrial sensitive environments where there is a strong probability that contamination exists at these locations.

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After reading all of this, you may feel a bit overwhelmed. It is important to keep in mind that this is a building process. Much of the data collected during the PA and SSI will be used for the LSI or will be augmented by data collected at the LSI stage. It is also important to remember that the revised HRS allows for new parameters to be considered, but it does not mean that data for all of them have to be collected. For instance, the Agency is proposing to use the amount of hazardous constituents as a means of calculating the hazardous waste quantity factor so that it is a more accurate reflection of relative risk. However, the Agency realizes that determining the amount of hazardous constituents within the hazardous wastes at a site is, in many cases, technically difficult. Therefore, a tiered approach has been proposed so that if these concentration data are not available, waste quantity as deposited could be used, as could source volume or source area. It is also worth remembering that if a factor under a specific category (e.g., total resident population under the targets category for the onsite exposure pathway) is assigned the maximum value, it may not be necessary to collect data for the remaining factors (i.e., high-risk population and terrestrial sensitive environments). However, do keep in mind that values for some factors may be changed during the review and comment period.

What, you might ask, does all of the preceding mean for those planning PAs and SIs (both SSIs and LSIs) under the revised HRS? First, in terms of background data collection, one should research and review available information sources to define the hydrogeology underlying the site; identify, locate, and inventory drinking water supplies within the new target distances; gather USGS stream flow data and fishery production data for surface water bodies near the site; obtain U.S. Census Bureau data to determine population within the designated ring distances; collect and review pertinent existing water, soils, and air monitoring data; and search files (e.g., State, EPA Region, etc.) for appropriate HRS data. With regard to site/environs reconnaissance data collection, one should attempt to delineate the "as deposited" site; identify nearby land uses and recreational water use; verify important distances (e.g., nearest well, school, residence) and dimensions (e.g., waste quantity areas, volume); and record sufficient observational information to satisfy the requirements for the containment factor. Last, in terms of revised site inspection sampling strategies (primarily applicable to LSIs), it is important to incorporate the following new data considerations: the onsite exposure pathway *requires* analytical demonstration of onsite contamination; emphasis should be placed on sampling to document *actual* exposure to drinking water contamination if there is reason to believe that such exposure exists; source and onsite samples may be needed to identify substances present and to delineate the "as deposited" site. Sampling primarily to "extend" the site is generally no longer appropriate—emphasis should be on proving the observed release. Sampling during SSIs (limited to 10-20 samples per site) should focus on identifying the types of contaminants present, assessing whether a release of hazardous substances has occurred, and looking for evidence of actual human and environmental exposure to contaminants.

Guidance for conducting PAs, SSIs, and LSIs using the revised HRS will be available from EPA Headquarters and Regional personnel once the HRS is published as a final rule. Whereas the *Bulletin* provides information on the collection of all of the data needed to complete the pre-remedial process, the guidance documents will focus on what specific data collection activities should be completed at each individual stage. Finally, please do refer to the *Federal Register* (Vol. 53, No. 247, pp. 51962-52081, December 23, 1988) for full information regarding the proposed revised HRS.

The SI/HRS Information Bulletin is published by the United States Environmental Protection Agency. For more information, contact Kevin Donovan at EPA Headquarters at (202) 475-9749 or Helene Kasser at NUS Corporation, (703) 522-8802.